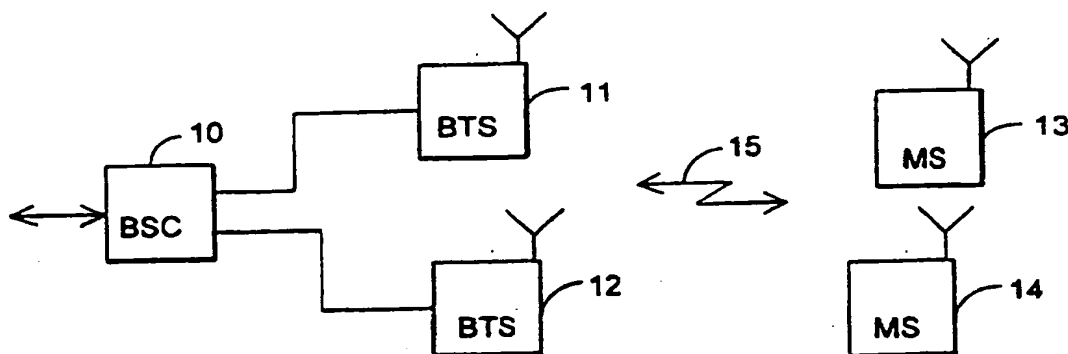




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : H04Q 7/38		A2	(11) International Publication Number: WO 97/46041
			(43) International Publication Date: 4 December 1997 (04.12.97)
(21) International Application Number: PCT/FI97/00316 (22) International Filing Date: 26 May 1997 (26.05.97) (30) Priority Data: 962216 27 May 1996 (27.05.96) FI (71) Applicant (for all designated States except US): NOKIA TELECOMMUNICATIONS OY [FI/FI]; Keilalahdentie 4, FIN-02150 Espoo (FI). (72) Inventors; and (75) Inventors/Applicants (for US only): HÄKKINEN, Hannu [FI/FI]; Vuokselantie 10 B, FIN-02140 Espoo (FI). KEU- RULAINEN, Jere [FI/FI]; Temppelikatu 1 C 22, FIN-00100 Helsinki (FI). HONKASALO, Zhi-Chun [GB/US]; 2800 L Don Dodson 1137, Bedford, TX 76021 (US). VIRT- NEN, Anu [FI/FI]; Kauppaneuvoksentie 10 A 1, FIN-00200 Helsinki (FI). RINNE, Mikko [FI/FI]; Mäkelänrinne 5 A 76, FIN-00550 Helsinki (FI). (74) Agent: TEKNOPOLOIS KOLSTER OY; Kolster Oy Ab, Iso Roobertinkatu 23, P.O. Box 148, FIN-00121 Helsinki (FI).		(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ARIPO patent (GH, KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG). Published Without international search report and to be republished upon receipt of that report.	

(54) Title: CONNECTION ESTABLISHMENT METHOD AND RADIO SYSTEM



(57) Abstract

The present invention relates to a connection establishment method and a radio system. When a base station (11) detects a preamble (20) from a subscriber terminal equipment (13), the power adjustment of a closed loop is started for controlling the transmission power of the subscriber terminal equipment (13). Signals (15) of the base station (11) and the subscriber terminal equipment (13) are synchronized and the subscriber terminal equipment (13) sends a randomly selected identifier. The identifier determines a transit channel to which the subscriber terminal equipment (13) suggests to move. The base station (11) may change the suggested transit channel and echo the identifier back to the subscriber terminal equipment (13), and the base station (11) and the subscriber terminal equipment (13) communicate on the transit channel from which they move to a traffic channel. The inventive method accelerates connection establishment.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece			TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	NZ	New Zealand		
CM	Cameroon			PL	Poland		
CN	China	KR	Republic of Korea	PT	Portugal		
CU	Cuba	KZ	Kazakhstan	RO	Romania		
CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		

CONNECTION ESTABLISHMENT METHOD AND RADIO SYSTEM

FIELD OF THE INVENTION

The invention relates to a connection establishment method in a radio system including one or more base stations and subscriber terminal equipments, in which system signals to be sent are multiplied by spreading codes, and in which the connection from the base station to the subscriber terminal equipment is synchronized and the subscriber terminal equipment has received the control data of the radio system from the base station and the subscriber terminal equipment sends an access signal to the base station on an access channel.

A radio system comprising one or more base stations and subscriber terminal equipments, in which system signals to be sent are multiplied by spreading codes, and where the connection from the base station to the subscriber terminal equipment is synchronized and the subscriber terminal equipment has received the control data of the radio system from the base station and the subscriber terminal equipment is arranged to send an access signal to the base station on an access channel.

BACKGROUND OF THE INVENTION

A typical cellular radio system, such as the CDMA system (Code Division Multiple Access) comprises a set of subscriber terminal equipments and base stations. When a subscriber terminal equipment does not have a connection on a normal traffic channel, it monitors the paging channel of a base station and when necessary, sends messages on an access channel to the base station. When a connection is established between the subscriber terminal equipment and the base station in a cellular radio system, either the subscriber terminal equipment or the base station sends a connection establishment request. In the CDMA cellular radio system, a specific Random Access Channel (RACH) is used as an access channel on which the subscriber terminal equipment initiates call establishment. The base station responds to the messages of the access channel on an Access Grant Channel (AGCH). In this case one phase is selected from among all the available phases of a pseudonoise code for a random access type connection. When a traffic channel connection is to be established or when responding to a connection establishment request of the base station, the terminal equipments send via the access channel a connection establishment message to the base

station which forwards it to other parts of the system, typically to a base station controller where traffic channel resources are allocated to the connection.

In the CDMA system, each base station sends continuously a pilot signal. If the base station has several sectors or beams, each sector or beam of the base station has typically a specific pilot signal. It is previously known to use a pilot signal for identifying a base station, a beam or sector of the base station. A pilot signal is a spread-coded signal without data modulation which signal each base station sends continuously to its coverage area. The terminal equipment may identify the base station transceiver units by the pilot signal because the phases of the spreading codes in the pilot signal differ from one another. The subscriber terminal equipments carry out measurements of pilot signals continuously.

In a typical CDMA system using direct sequence, the transmitter and the receiver have to be synchronized so that the sequence of the received signal and the sequence of the local oscillator are in the same phase. Continuous code channels, such as the pilot channel, can be used for synchronization in the direction of transmission from the base station to the subscriber terminal equipment. The subscriber terminal equipment can search for the code phase and thus synchronize to the transmission of the base station. In the opposite direction of transmission from the subscriber terminal equipment to the base station, the subscriber terminal equipment starts the transmission and the base station searches for the code phase. In the direction of transmission from the subscriber terminal equipment to the base station a problem is caused by the distance of the subscriber terminal equipment from the base station, that is, by a near-far problem. In that case, the subscriber terminal equipment has to estimate the suitable transmission power. The base station cannot, however, control the transmission power of the subscriber terminal equipment until it has synchronized itself to the correct code phase.

In addition to a circuit-switched connection, the base station and the subscriber terminal equipment can communicate also on a packet-mode connection which is used in the PRMA system (Packet Reservation Multiple Access). In that case the channel needed for sending the signal is only reserved for the duration of the signal at that moment and it is released immediately when the signal is discontinuous or when it ends or has a break. If the signal is sent discontinuously, the connection is synchronized and the

channel is reserved again after each break. In a packet-mode transmission, a transfer from one carrier frequency to another and the re-establishment of a connection require a fast access process.

The prior art access process, which typically lasts hundreds of
5 milliseconds, restricts by its slowness the performance of the radio system and strains the resources. Furthermore, as the establishment of a connection takes a long time and the transmission power of the subscriber terminal equipment cannot be controlled during that time, the subscriber terminal equipment causes interferences in the radio system.

10 CHARACTERISTICS OF THE INVENTION

The object of the present invention is to implement fast synchroni-
zation for the base station to the transmission of the subscriber terminal
equipment when establishing a connection. A further object is to have the
transmission power of the subscriber terminal equipment fast under the control
15 of the base station.

This object is attained by a method shown in the prior art portion
which is characterized in that when establishing a connection, the subscriber
terminal equipment transmits on the access channel essentially at most: a
preamble including sync data of the spreading code, a timing sync portion
20 which includes a synchronization word and with which at least an identifier is interpreted, and an identifier including at least data on the subscriber terminal equipment.

The radio system of the invention is characterized in that the access
signal of the subscriber terminal equipment comprises: a preamble comprising
25 sync data of the spreading code, a timing sync portion which includes a
synchronization word and with which at least an identifier is interpreted, and
an identifier comprising at least data on the subscriber terminal equipment.

Considerable advantages are attained with the method of the
invention. It accelerates connection establishment and diminishes interference
30 by having the subscriber terminal equipment fast under power adjustment
control of the base station, for example.

BRIEF DESCRIPTION OF THE FIGURES

In the following, the invention will be explained in more detail with
reference to the appended drawings, wherein

35 Figure 1 shows the radio system,

Figure 2 shows an access process,

Figure 3 shows a flow diagram of the operation of the subscriber terminal equipment,

Figure 4 shows a flow diagram of the operation of the base station,

5 Figure 5 shows a transmitter, and

Figure 6 shows a receiver.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The solution of the invention is particularly suitable to be used in the CDMA system without restricting thereto. In the following, the invention will be
10 described in more detail by using the CDMA system as an example.

Figure 1 shows a typical radio system, preferably a cellular radio system comprising a base station controller 10, base stations 11 and 12 and subscriber terminal equipments 13 and 14. The subscriber terminal equipments 13 and 14, which are preferably mobile phones, are connected to
15 the base stations 11 and 12 whose coverage areas form cells. Signalling between the base stations 11 and 12 and the subscriber terminal equipments 13 and 14 is illustrated in Figure 1 by a two-headed arrow with numeral 15. The signals 15 to be sent are formed by multiplying data by the spreading code. The signals of the subscriber terminal equipments 13 and 14 are
20 differentiated from one another by the mutual phase difference of the spreading codes or by different codes. The base stations 11 and 12 send signals which are transmitted by the base station controller 10. The base stations 11 and 12 forward the signals received from the subscriber terminal equipments 13 and 14 to the base station controller 10. The connection of the
25 base stations 11 and 12 to the base station controller 10 typically takes place by a digital transmission link. The base station controller 10 is connected to other parts of the network, such as the mobile services switching centre (not shown in the figure) from which there are typically connections to other mobile services switching centres and to exchanges of other networks.

30 The access signal is examined in more detail by means of Figure 2. In the solution of the invention, when the downlink connection is already synchronized, the subscriber terminal equipment 13 transmits repeatedly a short preamble 20 on access channel RACH on an increasing transmission power as long as the base station 11 will hear it. When the base station 11
35 does not hear the transmission of the subscriber terminal equipment 13, the base station 11 transmits a "power-up" command 24. When the base station

11 detects the preamble 20 on the RACH channel, the base station 11 transmits a "power-down" command 25 and the transmission power of the subscriber terminal equipment 13 is transferred to a closed loop adjustment 26 in the inventive solution known per se in the prior art. When the subscriber terminal equipment 13 detects the "power-down" command, which is an indication of the base station 11 having successfully received the preamble 20 of the access signal, it transmits preferably a sync portion comprising a synchronization word 21. By means of the synchronization word 21, at least the timing of the initial part and end part of the identifier 22 are synchronized.

10 The synchronization word typically gives an unequivocal reference time for the uplink connection to be established. By means of it, it is possible to interpret the identifier 22 and the allowed starting points of the transit channel. By means of the synchronization word, the base station 11 finds out the signal timing the subscriber terminal equipment 13 uses in its uplink connection. After this the subscriber terminal equipment 13 also transmits the identifier 22 which determines the subscriber terminal equipment that transmits it. This takes place for example so that the subscriber terminal equipment 13 selects a random identifier which the base station 11 repeats. Thus it is confirmed that the subscriber terminal equipment 13 and the base station 11 follow one another. In the solution of the invention, the identifier also suggests a specific inventive transit channel to be used. This suggestion may be implemented for example so that the transit channel is a function or a relation of the identifier 22. A typical solution would be for example such that a specific transit channel is tabulated for a specific identifier 22. After this the connection of the base station 11 and the subscriber terminal equipment 13 is moved to the transit channel and therefrom further to a traffic channel (not shown in Figure 2).

By means of the identifier, the inventive transit channel is determined in the method, to which channel transit occurs from the access channel RACH. The purpose of using the transit channel is to release the access channel as fast as possible for new connection establishment. After having received the access channel RACH, the base station 11 acknowledges it by an "access granted" signal on the AGCH channel (Access Grant Channel). This "access granted" signal AGCH contains, when needed, correction data on the transit channel if the transit channel suggested by the subscriber terminal equipment 13 is reserved or otherwise unsuitable. By means of the correction data, the subscriber terminal equipment 13 can move

to the correct transit channel. The correction data contains as little as possible information, 2 bits being sufficient, for example. If no transit channel can be allocated to the use of the subscriber terminal equipment 13, the connection is broken off and the connection establishment can start again.

5 Either a short or a long spreading code can be used for spreading the access signal in the solution of the invention. When using a short spreading code at least with the preamble 20, the synchronization word 21 and the identifier 22 can also be spread with a short spreading code. The preamble 20 is actually preferably no more than a short spreading code. The
10 short spreading code comprises at most only hundreds of spreading codes, that is, chips, whereas the long spreading code of the prior art typically contains tens of thousands of chips or even considerably more. A short spreading code allows a simpler receiver structure than a long spreading code.

15 When using a long spreading code, it is not necessary in the solution of the invention to move from the access channel to the transit channel as the known starting point of the long code determines the synchronization and independent connection-specific channel where signalling can be continued. A long spreading code can be used all the time or it can be
20 enabled after the preamble 20, the synchronization word 21 or the identifier 22. The use of the transit channel is also possible even in this case. It is most significant at this stage of the inventive solution that the access channel and generally the organization channel and the resources connected thereto are released for other connections.

25 The subscriber terminal equipment 13 measures the pilot signals of the base stations 11 and 12, whereby the subscriber terminal equipment 13 can estimate the path loss and make an estimate of the transmission power of the access signal. A clearly smaller power than the estimated required power is typically used at first as a transmission power in order to avoid interferences.
30 In the implementation of the invention, the subscriber terminal equipment 13 selects preferably as the transmission power a random power below the estimated required power. In this way it is possible to randomize the detection of several subscriber terminal equipments which establish a connection at the same time at the base station.

35 As the preamble 20 of the access signal does not yet inform the base station from which subscriber terminal equipment the access signal is

received, the base station may accept access signals of several subscriber terminal equipments at the same time in the solution of the invention. The base station differentiates the subscriber terminal equipments from one another on the basis of the phase of the spreading code, which is particular for each subscriber terminal equipment due to the distance between the base station and the subscriber terminal equipment, for example. The base station may continue establishing a connection in parallel with several subscriber terminal equipments. In practice, the access channel is common as only the echoing of the identifier is specific for each subscriber terminal equipment.

5 This is correct for both short and long spreading codes. Especially when using a short spreading code, it is possible but only with a low probability that both the spreading code and the phase of the spreading code of two subscriber terminal equipments are the same, in which case a collision occurs. If this should occur, the connection establishment of the collided subscriber terminal equipments is started again. The collision probability can be diminished by using a long spreading code or even several, possibly long spreading codes, but their use will complicate the receiver structure.

10

15

In the solution of the invention, it is possible to map the identifier 22 and the transit channel in many ways. They can be arranged as a table in which case a specific identifier 22 corresponds to a specific transit channel. A mapping rule on the system level may also be used. In that case a pilot signal, for example, defines the transit channels used in each cell, from which channels the subscriber terminal equipment is able to select. There may also be fewer transit channels in use than identifiers 22 since a great number of identifiers 22 diminishes the risk of collision, whereas the number of transit channels is dependent on the capacity of the system.

20

25

When the connection has just been switched off, especially in a packet-mode transmission, and the connection is to be established again with the same base station 11 and the subscriber terminal equipment 13, the base station 11 uses a narrower time window than usual, from which it searches for the access signal of the subscriber terminal equipment 13, because the phase delay of the spreading code in the previous connection is kept in memory for some time. The time window is the delay interval of the spreading code from which the base station 11 searches for the subscriber terminal equipment 13.

30

35 Also, the power level of the previous connection is utilized in such a manner that the receiver of the base station 11 waits for a similar signal power level as

at the end of a previous connection, corrected by a possible modification of connection attenuation. The subscriber terminal equipment 13 can detect this modification by measuring the change in the strength of the pilot signal. In that case the power level is typically greater than at any other time at the beginning
5 of the connection.

In the solution of the invention, the receiver of the base station 13 detects all the possible phases of the spreading code at the same time, in which case synchronization is very fast when signal strength is high enough. A typical receiver meeting the requirement of the invention may comprise a filter,
10 for example, that forms a correlation to all phases of the spreading code at the same time. A delay producing the greatest correlation reveals the phase of the spreading code. Correlation $C[\tau]$ can be calculated, for example, with the formula

$$15 \quad C[\tau] = \int_a^b S[t] \cdot M[t + \tau] dt,$$

where a and b represent moments of time, $S[t]$ is a received signal and $M[t + \tau]$ comprises all the combinations of the spreading code with delay τ . In the case of digital signals, the integral can be replaced by summing.

20 Prior art diversity combination technique can also be used in the receiver, in which case signal energy can be gathered better and signal noise rate can be improved. In such multipath reception, the most ordinary diversity receivers combine signals before or after detection and they comprise selective combining, maximal-ratio combining and equal-gain combining, for
25 example.

The typical process of the invention is now examined more closely in flow diagrams 3 and 4. Figure 3 illustrates a flow chart of the operation of the subscriber terminal equipment in the inventive connection establishment. When the subscriber terminal equipment starts establishing the connection on
30 the RACH channel, the initial situation is 300. Then the subscriber terminal equipment transmits a preamble in step 301. After this the subscriber terminal equipment remains a restricted period of time in step 302, waiting for a "power-up" command. If the base station requires more transmission power, the subscriber terminal equipment moves to state 303 where it raises its
35 transmission power. This state is abandoned after the transmission power is suitable for the base station. If the waiting time is exceeded in step 302 or

state 303 has been abandoned, step 304 is moved to where the subscriber terminal equipment waits for a sending request of a synchronization word from the base station. If the request is not received, the subscriber terminal equipment moves back to state 301 where it sends the preamble. If the request is received, the subscriber terminal equipment sends a synchronization word in step 305. This request is preferably also information on that the base station starts to control the transmission power of the subscriber terminal equipment. Alternatively, the base station informs of starting power adjustment on a response channel. After this in step 306 the subscriber terminal equipment sends an identifier (ID) it has selected at random, and the subscriber terminal equipment remains waiting in step 307 for the echoing of the identifier from the base station. If the base station does not repeat the identifier during waiting in 307, the subscriber terminal equipment is restored to the transmitting state 301 of the preamble. If the subscriber terminal equipment receives a wrong identifier, the subscriber terminal equipment moves to state 306 where it sends the identifier again. If the base station echoes the identifier correctly, the subscriber terminal equipment moves to state 309 where the subscriber terminal equipment moves to the transit channel and releases the RACH channel for other users.

Figure 4 shows a flow diagram of the operation of the base station in inventive connection establishment. The operation of the base station starts in step 400 at the beginning of the flow diagram. There the base station waits for the preamble of the access signal of the subscriber terminal equipment. In step 402 it is tested if the received signal exceeds a threshold value. If this is not the case, waiting is continued in step 401. If the signal was detected, a "power-up" command is sent in step 403 and in step 404 it is compared if after power has been raised, the correlation is the same as when the signal is detected. If the correlation is at a different point, power adjustment was not done for the detected subscriber terminal equipment and it returns to the start to wait in step 401. If the correlation is at the same place, the subscriber terminal equipment is requested the synchronization word in step 405, after which the base station remains waiting in step 406. If the synchronization word is not received in step 407, step 408 is moved to where the base station informs that it moves to the initial state in step 401 to wait. If the synchronization word is received within the allowed time, the base station receives it in step 409. After that the base station checks the availability of the

transit channel in step 410. When the transit channel is available, the base station moves further to state 411 from which it sends the identifier of the subscriber terminal equipment back for checking. At the same time it can change by mapping the transit channel suggested by the subscriber terminal equipment. Next the base station stays waiting in step 412 for the appearance of the subscriber terminal equipment on a specified transit channel. If the subscriber terminal equipment does not appear on the transit channel within the allowed time in step 413, the base station moves to state 408. If the subscriber terminal equipment does not appear on the transit channel but there is some of the allowed time left, the base station may move to state 409 where it receives the identifier again. Otherwise the base station moves to wait for the new preamble and in a successful case serves a subscriber terminal equipment that has just left the RACH channel on a transit channel where it can receive the identifier again. Other signalling, such as a response to a paging message, needed in connection establishment, is started on the transit channel. When necessary, moving to an actual traffic channel is also agreed upon there. Thus also the transit channel is released to be used again.

Figure 5 shows the main features of a base station transmitter which comprises a multiplier 50, a spreading code generator 51, radio frequency means 52, a filter 53 and an antenna 54. Digital data sent by the base station is first received by the multiplier 50 where data is multiplied, that is, spread according to prior art by a digital spreading code of the spreading code generator 51. Spreading code chips are shorter than data bits. The spread signal propagates to a second multiplier 50 where the digital signal is multiplied by a high-frequency carrier wave. After this at least low frequencies are removed from the high-frequency signal by the filter 53 from which the signal propagates to the antenna 54. The spreading code of the spreading code generator 51 can be long or short.

Figure 6 shows the main features of a base station receiver. Similarly as the transmitter, the receiver comprises an antenna 54, a filter 53, a multiplier 50, and RF means 52. The receiver also comprises a correlator 60. The frequency of a radio-frequency signal received from the antenna 54 is transferred to a low intermediate frequency by using the multiplier 50 where the signal is multiplied by oscillator radio frequency, and the filter 53. After this, the correlator searches for the transmitted bits or bit combinations from the received signal. In the solution of the invention, the correlator is such that it

can detect all the phases of the spreading code at the same time. In that case the long spreading code makes it more complicated than a short spreading code. The signal propagates from the correlator 60 to other parts of the base station.

- 5 The implementation of the invention employs known radio technique and digital signal processing circuits which are ASIC or VLSI based and whose operation can be controlled by means of software by micro-processor technique.

- 10 Although the invention has been explained above with reference to the examples of the appended drawings, it is evident that the invention is not restricted thereto, but it can be modified in various ways within the scope of the inventive idea disclosed in the accompanying claims.

CLAIMS

1. A connection establishment method in a radio system including one or more base stations (11 and 12) and subscriber terminal equipments (13 and 14), in which system signals (15) to be sent are multiplied by spreading codes, and in which the connection from the base station (11) to the subscriber terminal equipment (13) is synchronized and the subscriber terminal equipment (13) has received the control data of the radio system from the base station (11) and the subscriber terminal equipment (13) sends an access signal to the base station (11) on an access channel, **characterized** in that when establishing a connection, the subscriber terminal equipment (13) transmits on the access channel essentially at most:

- a preamble (20) including sync data of the spreading code,
- a timing sync portion (21) which includes a synchronization word and with which at least an identifier (22) is interpreted, and
- an identifier (22) including at least data on the subscriber terminal equipment (13).

2. A method according to claim 1, **characterized** in that the preamble (20) is sent as long as the base station (11) will detect the preamble (20) and start the power adjustment of a closed loop, which will keep the transmission power of the subscriber terminal equipment (13) correct, and the starting of which informs the subscriber terminal equipment (13) that the reception of the preamble (20) of the access signal has been successful.

3. A method according to claim 1, **characterized** by moving from the access channel to the transit channel, and determining the transit channel in a previously known manner on the basis of the identifier (22) and using the transit channel before moving to a traffic channel.

4. A method according to claim 3, **characterized** in that when the transit channel of the identifier (22) is unsuitable, the base station (11) changes the transit channel into a suitable one and informs the subscriber terminal equipment (13) of it, or when even this is impossible, the connection is switched off and connection establishment is started again.

5. A method according to claim 4, **characterized** in that when the transit channel of the identifier (22) is unsuitable and when the transit channel is changed into a suitable one, the base station (11) sends

information about the new transit channel by a few bits to the subscriber terminal equipment (13).

6. A method according to claim 1, **characterized** in that a short spreading code is used for spreading at least the preamble (20).

5 7. A method according to claim 1, **characterized** in that when using a long spreading code for the timing sync portion (21) and for the identifier (22) for sending the access signal, signalling is continued with said long spreading code.

8. A method according to claim 1, **characterized** in that the
10 subscriber terminal equipment (13) sends the access signal so that a randomly selected transmission power is used at first.

9. A method according to claim 1, **characterized** in that the base station (11) is connected on the access channel to several subscriber terminal equipments (13 and 14) when sending the access signal (20),
15 whereby

the subscriber terminal equipments (13 and 14) are differentiated from one another by the phases of the spreading code, and

the differentiation of the subscriber terminal equipments (13 and 14) takes place on the basis of the identifiers (22) of the subscriber terminal
20 equipments (13 and 14).

10. A method according to claim 1, **characterized** in that when the timing window is the delay interval of the spreading code from which the base station (11) searches for the signal, especially in a packet-mode operation, soon after having switched off the connection when connection
25 establishment is started again, a smaller time window is used in the receiver of the base station (11) and a greater transmission power is expected of the subscriber terminal equipment (13) in comparison to the usual.

11. A method according to claim 1, **characterized** in that the base station (11) detects essentially all the phases of the spreading code in
30 use at the same time.

12. A radio system comprising one or more base stations (11 and 12) and subscriber terminal equipments (13 and 14), in which system the signals to be sent are multiplied by spreading codes, and where the connection from the base station (11) to the subscriber terminal equipment
35 (13) is synchronized and the subscriber terminal equipment (13) has received the control data of the radio system from the base station (11) and the

subscriber terminal equipment (13) is arranged to send an access signal to the base station (11) on an access channel, **characterized** in that the access signal of the subscriber terminal equipment (13) comprises:

- a preamble (20) comprising sync data of the spreading code,
- 5 - a timing sync portion (21) which includes a synchronization word and with which at least an identifier (22) is interpreted, and
- an identifier (22) comprising at least data on the subscriber terminal equipment.

13. A radio system according to claim 12, **characterized** in
10 that the power adjustment of the closed loop is arranged to be started after the detection of the preamble (20) at the base station (11) and to keep the transmission power of the subscriber terminal equipment (13) correct, and the starting of which the power adjustment is an indication to the subscriber terminal equipment (13) that the reception of the preamble (20) of the access
15 signal has been successful at the base station (11).

14. A radio system according to claim 13, **characterized** in that the transit channel to which the moving of the connection from the access channel is arranged, is determined in a predetermined manner on the basis of the identifier (22) and the transit channel is arranged to be used before moving
20 to the traffic channel.

15. A radio system according to claim 13, **characterized** in that when the transit channel of the identifier (22) is unsuitable, the base station (11) is arranged to change the transit channel into a suitable one or when even this is impossible, the base station (11) is arranged to switch off
25 the connection and connection establishment is arranged to be started again.

16. A radio system according to claim 15, **characterized** in that when the transit channel of the identifier (22) is unsuitable and when the transit channel is changed into a suitable one, the base station (11) is arranged to send information about the new transit channel by a few bits to the
30 subscriber terminal equipment (13).

17. A radio system according to claim 13, **characterized** in that at least the preamble (20) is spread by a short spreading code.

18. A radio system according to claim 13, **characterized** in that when the timing sync portion (21) and the identifier (22) have been spread
35 by a long spreading code, signalling is arranged to be continued with said long spreading code.

19. A radio system according to claim 12, **characterized** in that the subscriber terminal equipment (13) is arranged to send the access signal at a randomly selected transmission power at first.

20. A radio system according to claim 13, **characterized** in
5 that the base station (11) is arranged to be connected on the access channel to several subscriber terminal equipments (13 and 14) when sending the access signal, whereby

there are differences between the phases of the spreading code of the subscriber terminal equipments (13 and 14), and

10 the differentiation of the subscriber terminal equipments (13 and 14) is arranged to take place on the basis of the identifiers (22) of the subscriber terminal equipments (13 and 14).

21. A radio system according to claim 13, **characterized** in that when the timing window is the delay interval of the spreading code from
15 which the base station (11) searches for the signal especially in a packet-mode operation, and when connection establishment is started again soon after having switched off the connection, the timing window is arranged to be smaller and the expected transmission power of the subscriber terminal equipment (13) greater than usual.

20 22. A radio system according to claim 13, **characterized** in that the base station (11) is arranged to detect at the same time all the phases of the spreading code in use.

1/3

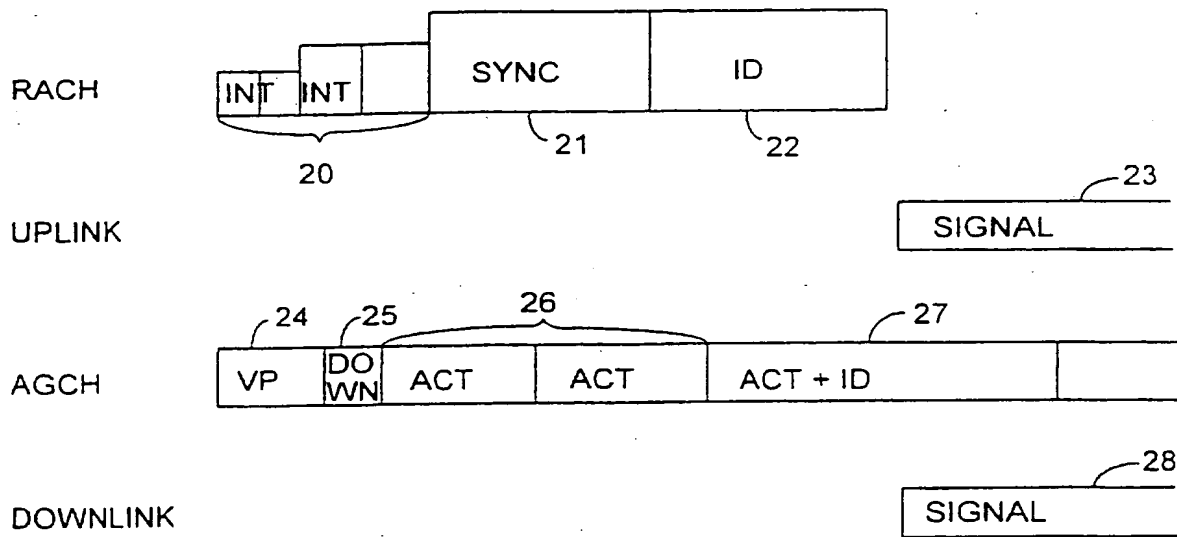
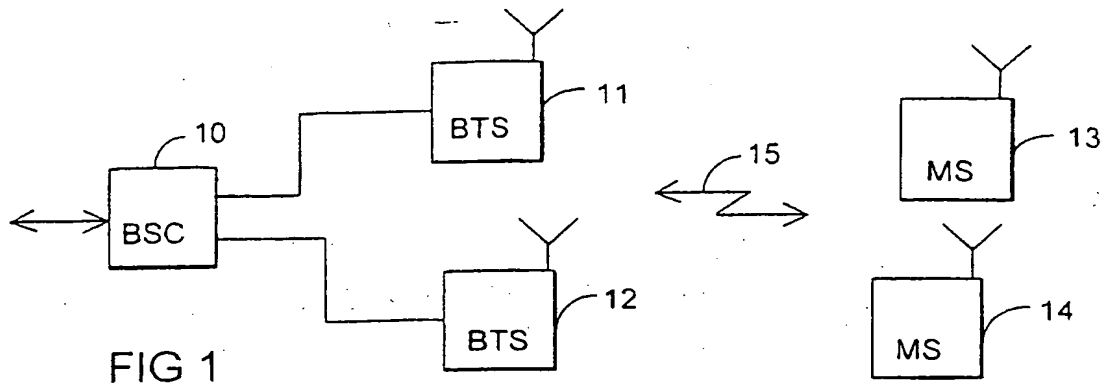


FIG 2

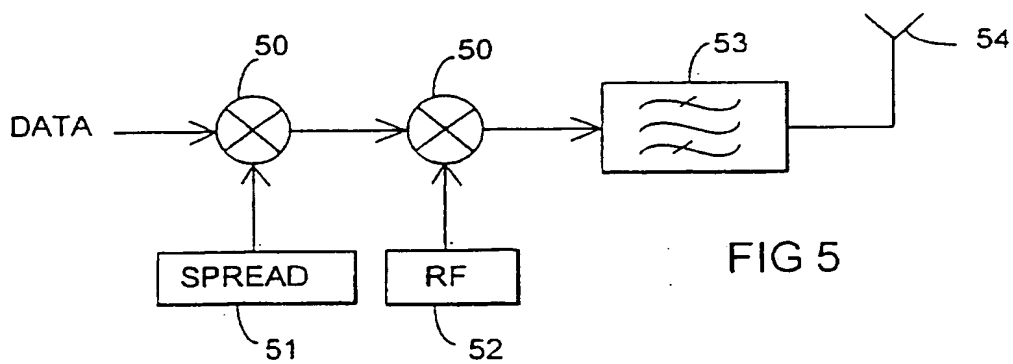


FIG 5

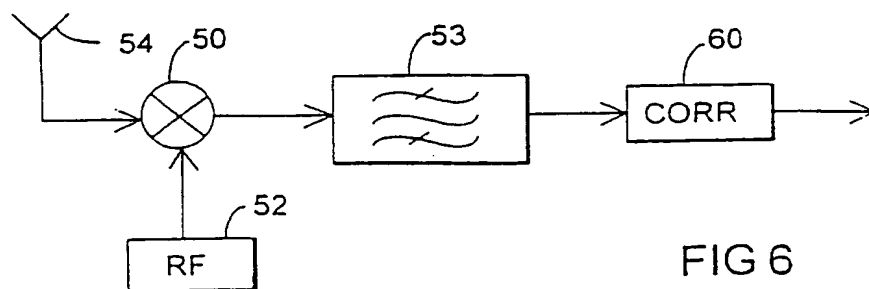


FIG 6

2/3

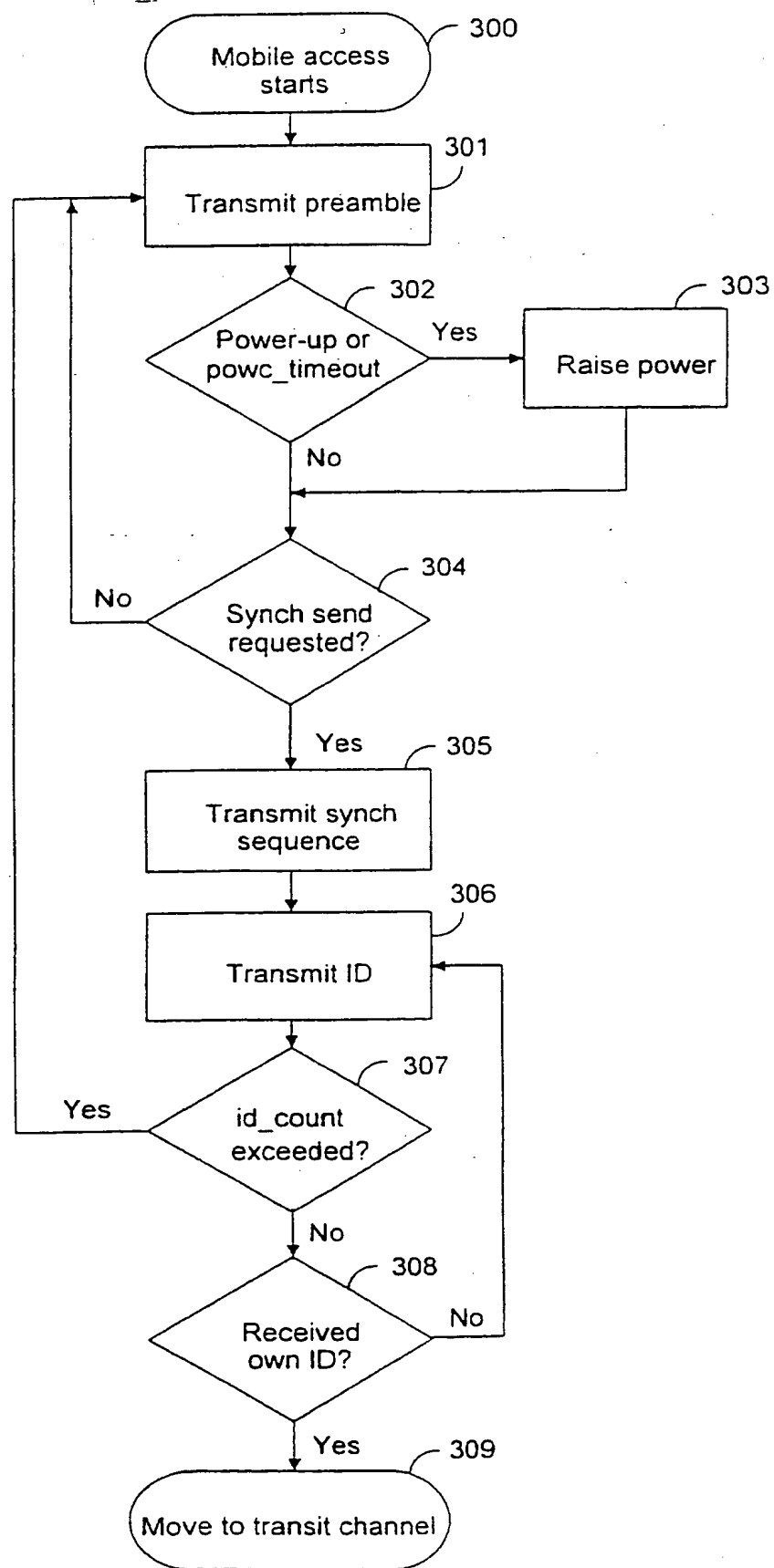


FIG 3

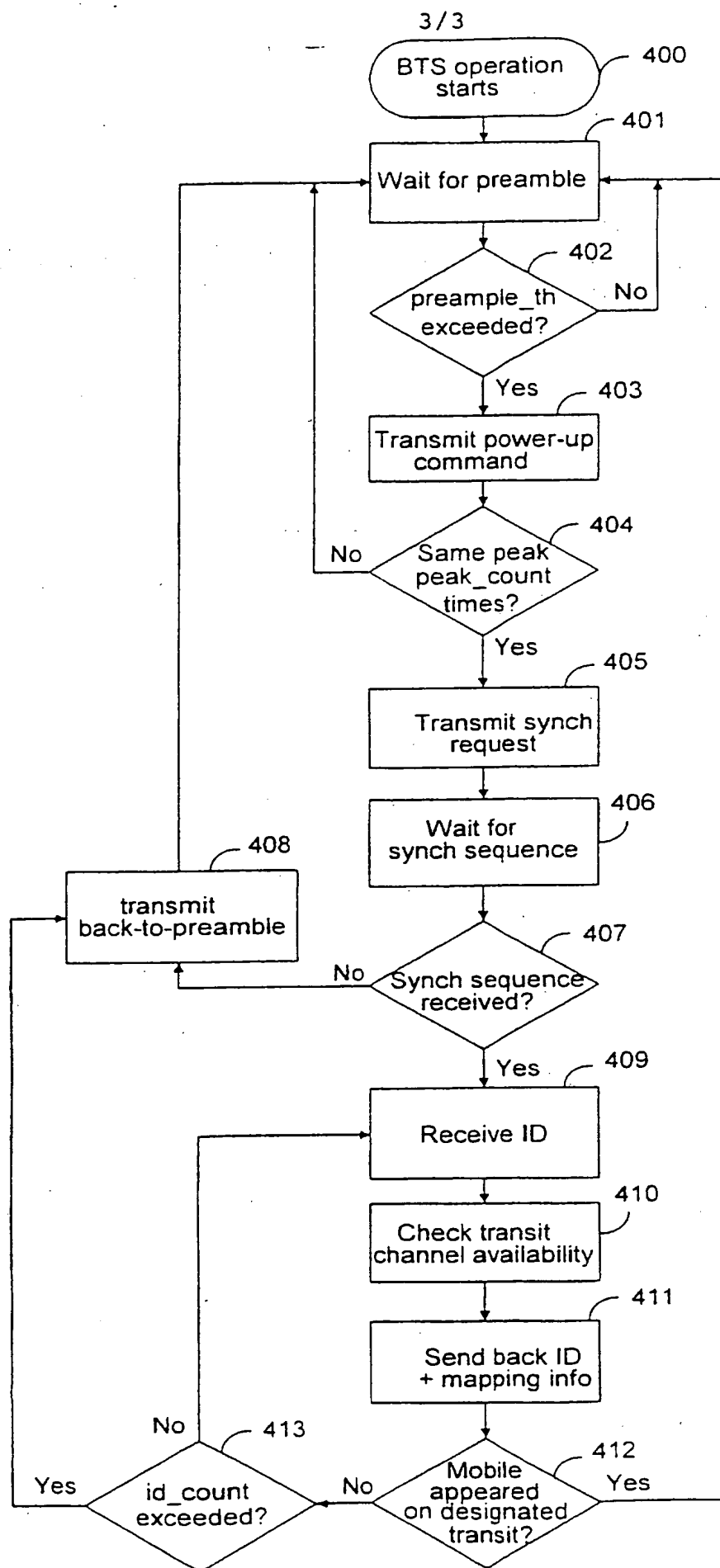
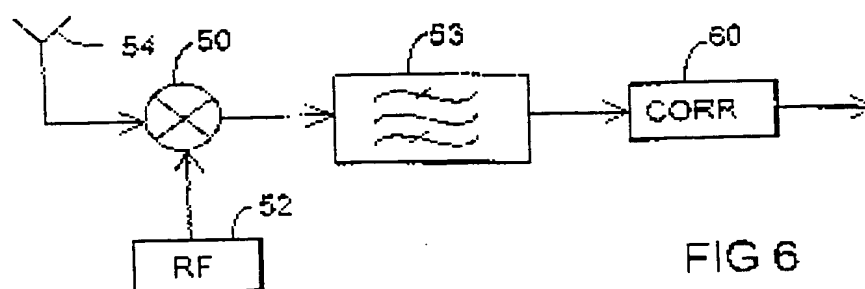
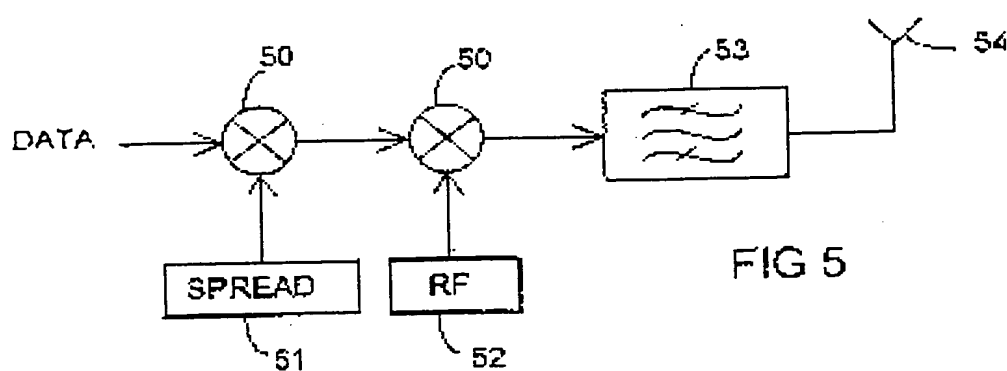
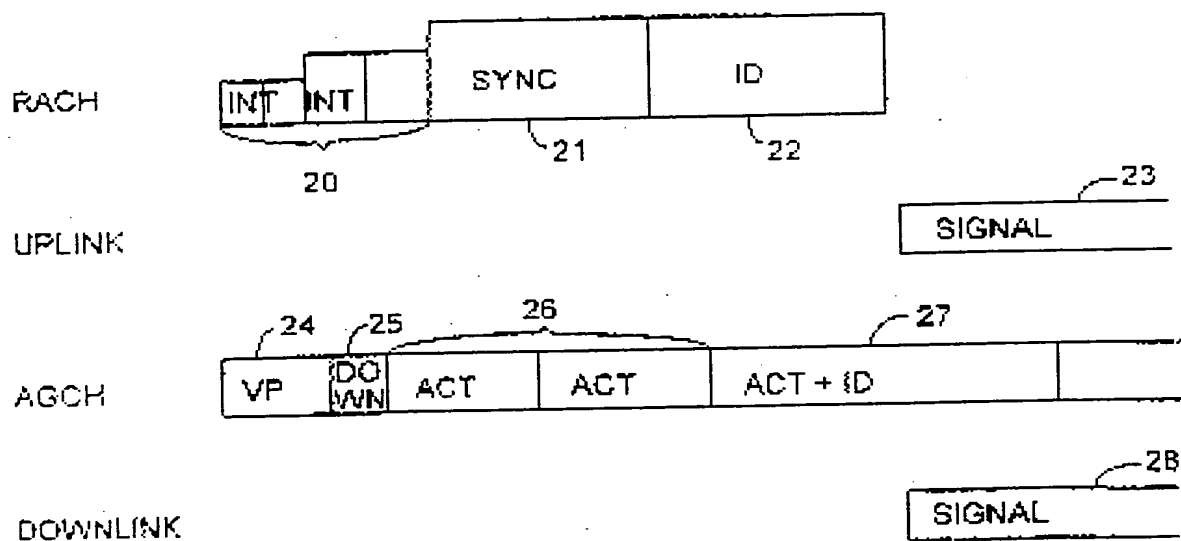
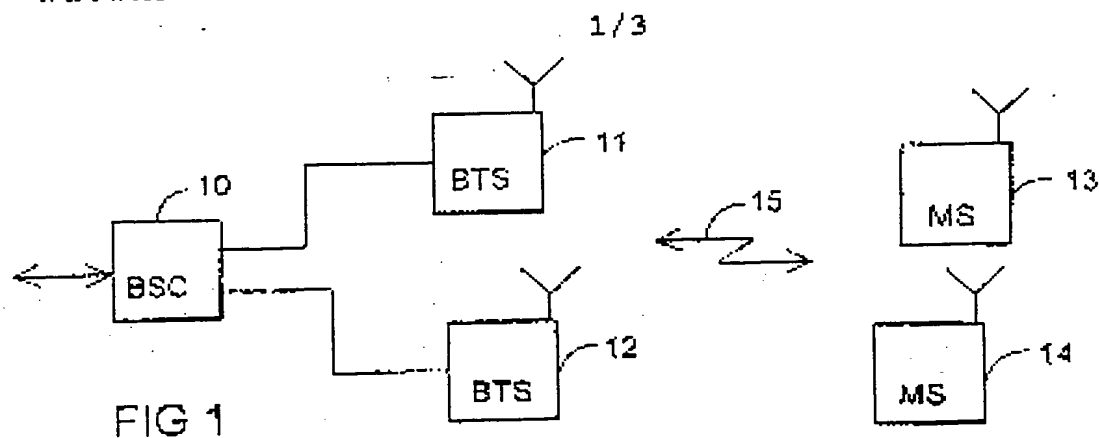


FIG 4



2 / 3

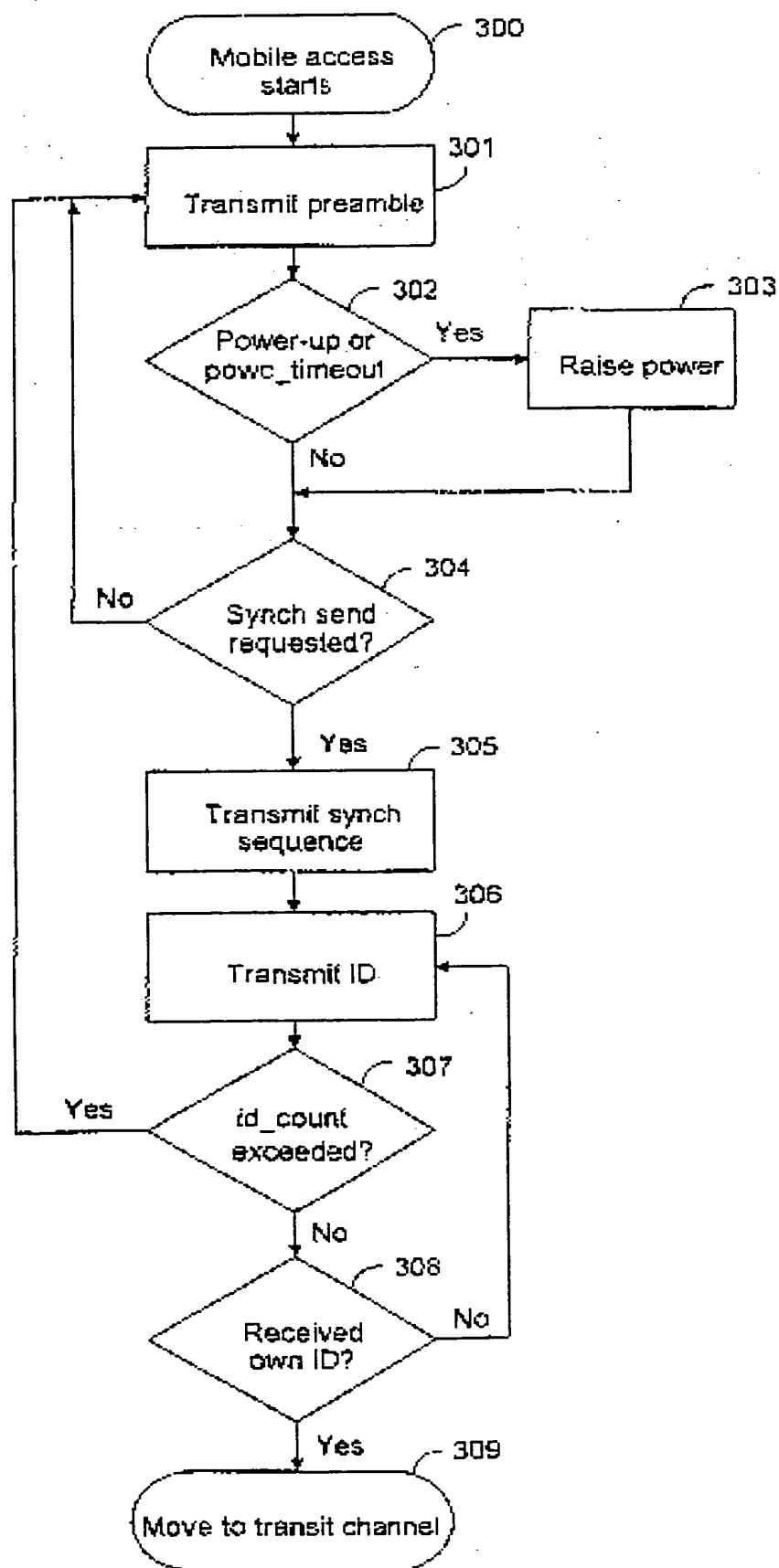


FIG 3

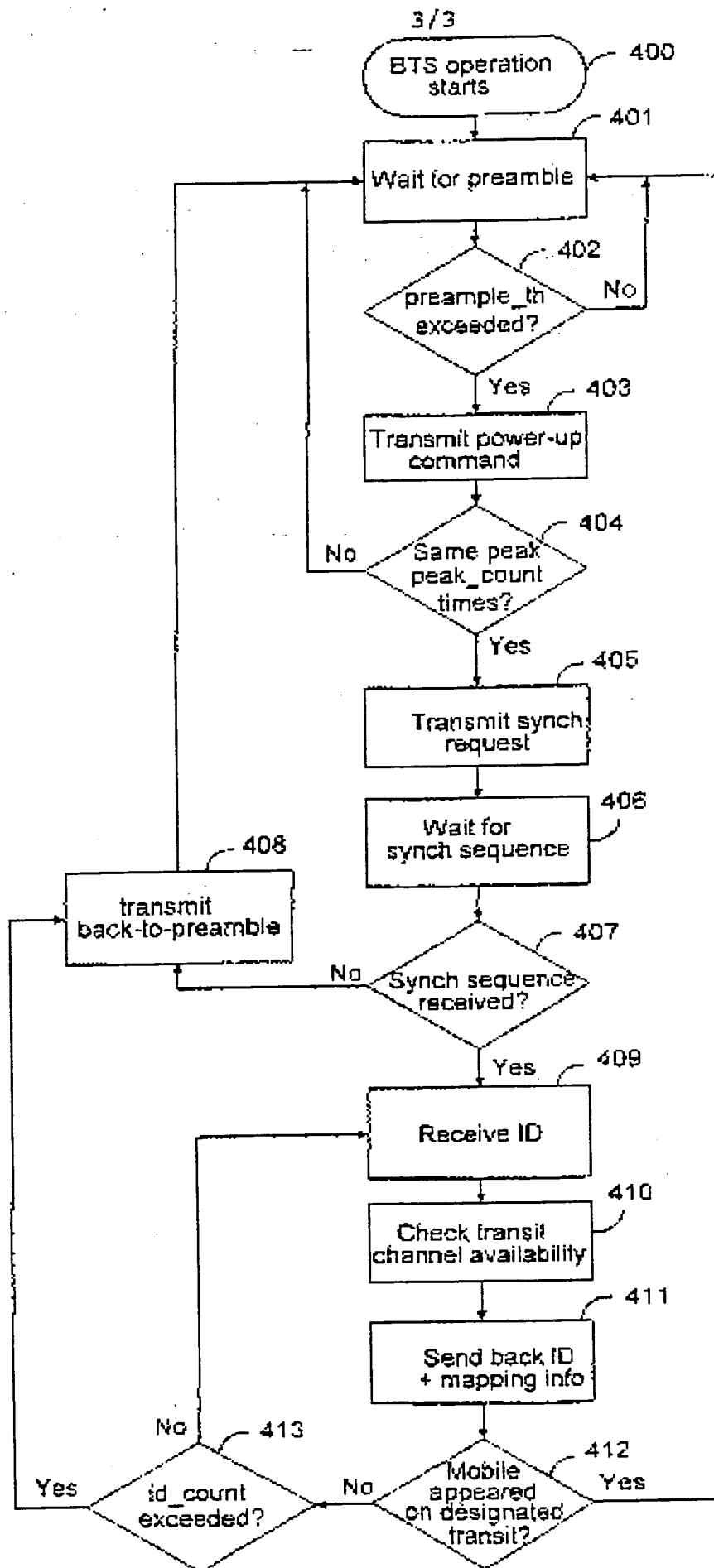


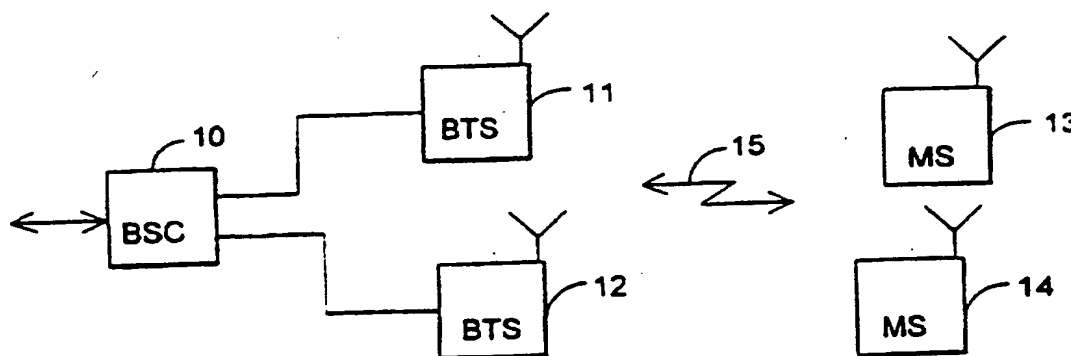
FIG 4



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : H04Q 7/38, H04J 13/04		A3	(11) International Publication Number: WO 97/46041
			(43) International Publication Date: 4 December 1997 (04.12.97)
(21) International Application Number: PCT/FI97/00316		(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ARIPO patent (GH, KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).	
(22) International Filing Date: 26 May 1997 (26.05.97)		Published With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.	
(30) Priority Data: 962216 27 May 1996 (27.05.96) FI		(88) Date of publication of the international search report: 31 December 1997 (31.12.97)	
(71) Applicant (for all designated States except US): NOKIA TELECOMMUNICATIONS OY [FI/FI]; Keilalahdentie 4, FIN-02150 Espoo (FI).			
(72) Inventors; and (75) Inventors/Applicants (for US only): HÄKKINEN, Hannu [FI/FI]; Vuokselantie 10 B, FIN-02140 Espoo (FI). KEURULAINEN, Jere [FI/FI]; Temppeliäkatu 1 C 22, FIN-00100 Helsinki (FI). HONKASALO, Zhi-Chun [GB/US]; 2800 L Don Dodson 1137, Bedford, TX 76021 (US). VIRTANEN, Anu [FI/FI]; Kauppaneuvoksentie 10 A 1, FIN-00200 Helsinki (FI). RINNE, Mikko [FI/FI]; Mäkelänrinne 5 A 76, FIN-00550 Helsinki (FI).			
(74) Agent: TEKNOPOLOIS KOLSTER OY; Kolster Oy Ab, Iso Roobertinkatu 23, P.O. Box 148, FIN-00121 Helsinki (FI).			

(54) Title: CONNECTION ESTABLISHMENT METHOD AND RADIO SYSTEM



(57) Abstract

The present invention relates to a connection establishment method and a radio system. When a base station (11) detects a preamble (20) from a subscriber terminal equipment (13), the power adjustment of a closed loop is started for controlling the transmission power of the subscriber terminal equipment (13). Signals (15) of the base station (11) and the subscriber terminal equipment (13) are synchronized and the subscriber terminal equipment (13) sends a randomly selected identifier. The identifier determines a transit channel to which the subscriber terminal equipment (13) suggests to move. The base station (11) may change the suggested transit channel and echo the identifier back to the subscriber terminal equipment (13), and the base station (11) and the subscriber terminal equipment (13) communicate on the transit channel from which they move to a traffic channel. The inventive method accelerates connection establishment.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakhstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 97/00316

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H04Q 7/38, H04J 13/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H04Q, H04B, H04J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPIL, JAPIO

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5511067 A (DAVID S. MILLER), 23 April 1996 (23.04.96), column 6, line 12 - line 18 --	1-22
P,A	US 5604730 A (EDWARD G. TIEDEMANN, JR.), 18 February 1997 (18.02.97), abstract --	1-22
P,A	EP 0749223 A1 (NTT MOBILE COMMUNICATIONS NETWORK INC.), 27 December 1995 (27.12.95), abstract -----	1-22

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"Z" document member of the same patent family

Date of the actual completion of the international search

13 November 1997

Date of mailing of the international search report

20-11-1997

Name and mailing address of the ISA/

Swedish Patent Office

Box 5055, S-102 42 STOCKHOLM

Facsimile No. +46 8 666 02 86

Authorized officer

Peter Hedman

Telephone No. +46 8 782 25 00

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT
Information on patent family members

01/10/97

International application No.
PCT/FI 97/00316

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5511067 A	23/04/96	AU 2775795 A	15/01/96
		CA 2193103 A	28/12/95
		EP 0766899 A	09/04/97
		WO 9535638 A	28/12/95
US 5604730 A	18/02/97	AU 3003195 A	22/02/96
		CA 2195984 A	08/02/96
		EP 0774179 A	21/05/97
		FI 970319 A	13/03/97
		IL 114703 D	00/00/00
		WO 9603813 A	08/02/96
EP 0749223 A1	27/12/95	ZA 9505843 A	15/03/96
		CA 2184184 A	04/07/96
		CN 1144585 A	05/03/97
		WO 9620544 A	04/07/96

**This Page is Inserted by IFW Indexing and Scanning
Operations and is not part of the Official Record**

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ **BLACK BORDERS**
- ☐ **IMAGE CUT OFF AT TOP, BOTTOM OR SIDES**
- ☒ **FADED TEXT OR DRAWING**
- ☐ **BLURRED OR ILLEGIBLE TEXT OR DRAWING**
- ☐ **SKEWED/SLANTED IMAGES**
- ☐ **COLOR OR BLACK AND WHITE PHOTOGRAPHS**
- ☐ **GRAY SCALE DOCUMENTS**
- ☐ **LINES OR MARKS ON ORIGINAL DOCUMENT**
- ☐ **REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY**
- ☐ **OTHER:** _____

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.